passes current for scientific lecturing nowadays is mere parrot-work; and lecturing which is confined to mere text-book recapitulation (such as could alone justify the author's intention that his book should be used in the lecture-room) is no lecturing at all, but rather a poor form of dictation work. We deem it the highest aim of a scientific lecturer to teach his hearers, by example, how best to extend, systematize, and apply their knowledge of crude facts previously acquired in the laboratory. He should in all cases work out from these and lead up to generalizations; and, to the end in view, he should be up to date in his reading, and, above all, cautious in his selection of approved topics. Given this line of action, the competent teacher could not fail to present his facts in a manner in which they could not be found in any text-book. The author of the work before us has clearly realized this position, and much of his book which we presume he would regard as the equivalent of lecture material, fulfils our ideal. We note, however, a too frequent want of judgment, and a too general desire to present theories before facts. By way of example, the inter-relationships of the Echinodermata are summarily dismissed in some ten or a dozen lines, in a manner as "cocksure" as it is certainly erroneous; and the beginner is told (p. 377) that the ribs of Vertebrates "perhaps bear the same relation to the vertebræ that the visceral arches do to the skull," before he either knows sufficiently what constitutes a rib, or at all appreciates the difficulties in the way of homologizing the ribs of the leading classes of Vertebrata. And here and there the author goes out of his way to raise difficulties at the outset (*e.g.* the opening sentence in the book, and the second sentence of p. 121), when dealing with terms having a definitely accepted meaning; while, in ushering in the Mollusca with a reference (p. 299) to "a diagrammatic summary of the chief anatomical characters" and a "schematic Archi-mollusk—a reconstruction of a possible ancestor," he proceeds along a line subversive of all good discipline established either on precedent or sound sense. There is here evidence of a topsyturveydom in method, which could only be productive of disastrous results.

Concerning the more strictly text-book portion of the volume, we confess to a similar attitude of mixed judgment. There is in it much that is admirable and beneficial, and not a little that is crooked and injurious. The gastræa theory is swallowed outright, mention of equally plausible alternative ones being confined (p. 62) to five none too fortunate lines. The description of the scapula (p. 472) as "a membrane bone," of the cranial nerves of vertebrates (p. 381) as ten in number; like the assertions (p. 444) that "it is very difficult to distinguish Amphibians from Fishes," that (p. 33) Volvox "is a hollow sphere of epithelium," that the skate's egg-purse is (p. 425) "composed of a horny substance allied to that of hair and hoof"; like definitions such as that of *Balanoglossus* and *Cephalodiscus* (p. 348) as "surviving incipient Vertebrates" (of course with a "notochord"), of *Lepidosiren* (p. 428) as "only a species of *Protopterus*," simply will not do; while arrangements such as those of the Mammalia (p. 7) and Vermes (p. 149) are hardly in keeping with modern conceptions.

Retrospective.—On retrospective examination of the book before us, we seek in vain for evidence of that impress of the author's individuality as an actual worker which has so often "made" the zoological text-book of the past. The author has been too content to abstract all in his way. Obsolete classifications are placed side by side with others as audacious as they are premature, and rival theories are alike abstracted for what they may be worth. When, however, the author's method leads to the citing (p. 86) of Kropotkin as an authority on evolution; to the placing side by side, as alternative interpretations of the phenomena of Nature, those generalized statements of facts which constitute the "laws" of Darwin, and the flighty fantasies shot at a venture by certain younger "law-makers" (some of whom are sufficiently candid to admit that they are generalizing without facts), willing to risk all if, perchance, a frivolous public will but proclaim them philosophers, the experienced naturalist, in whose hand the judgment lies, steps in and demands a reconsideration. In a word, the author has insufficiently exercised his judgment in selection of material. To the teacher of science the duty of showing his scholars, by inference, what to neglect is, perhaps, of paramount importance to that of indicating upon what they are to rely. The author of the volume under review would, however, leave the discretion in the hands of the student; he writes rather as the amateur, to whom everything is equally important, and in thus acting he fails to recognize one of the highest functions of his office, to the utter confusion, if not the ruin, of his followers. In our opinion, his book, although in many respects admirable, falls short in each of its great departments which we have signalized. It will be largely used, and we wish it an ultimate success. It nevertheless contains the framework of a really serviceable text-book; and if the author will elaborate this, using a fitting exercise of judgment, and either eliminating the illustrations altogether or replacing them in others better and more numerous, he ought to produce a work of more than passing value, and he would sufficiently justify the great pains at which he has placed himself. In its present form the book is calculated to encourage a love of premature generalization, and anyone adopting its methods would teach fantasies before facts. The mental attitude which it typifies is one apt to create a bias, under which the student would suffer in his after work, as is indeed exemplified by the author himself in his treatment (pp. 178-79) of the reproductive organs of the worm. To encourage this is but to foster a growing evil. The didactic method of instruction in zoology now in vogue will unmistakably prevail in the future; but, unless its dryness be salted with work akin to the good old-fashioned field work, to the discouragement of the more modern and pedantic phylum-mongering and striving after impossibilities, better, by far, the *régime* of the past.

G. B. H.

WATTS' "DICTIONARY OF CHEMISTRY."

Watts' Dictionary of Chemistry. Vol. III. By Forster Morley and M. M. Pattison Muir. (London: Longmans, 1892.)

THE third of the four volumes of this excellent work has just appeared, and in value and interest this one does not stand behind the two previous volumes.

Amongst the articles written by eminent specialists, one, the most important, is that contributed by Prof. J. J. Thomson, of Cambridge, on the theories of the molecular structure of bodies. It is from the interpretation of chemical phenomena, by the help of exact physical research, that we may most hopefully look for insight into the true explanation of these phenomena. And although the theory of the molecular constitution of matter now universally held has been adopted as regards chemical change ever since the publication of Dalton's new system of chemistry in 1808, the crucial proof of its necessity has only recently been given. Prof. Thomson briefly but clearly explains the historical development of this proof. The first attempt was made by Cauchy, founded on the dispersion which light experiences when it passes through transparent bodies. But this attempt was an incomplete one, and a less ambiguous proof was given by Osborne Reynolds in 1879, based upon the thermal effusion of gases. Lord Kelvin, Loschmidt, and others have gone still further, not only proving that matter possesses structure, but giving limits below which the "coarse-grainedness" of matter cannot lie. These conclusions are founded upon considerations of several distinct sets of phenomena, viz. surface-tension, the difference of potential which occurs when two metals are placed in metallic connection, the amount of polarization at the surface of an electrode and of an electrolyte, and the viscosity, the diffusion, and the conductivity for heat, of gases. The discussion of the methods by which the limit is reached in the case of surface tension is next clearly given, and the result arrived at that a thickness of 10^{-8} cm. must be comparable with the range of molecular action of the water molecules. The results of the well-known researches of Quincke on silver films and on capillary elevation, as summarized in a lecture delivered before the Chemical Society of London by Prof. Rücker in 1888, are then explained, and the limits of molecular action deduced from these experiments. Having given an idea of the coarse-grainedness of matter, Thomson proceeds to consider the various theories of that structure, and gives an account of the most important of these by Lord Kelvin and Lindemann. The evidence of molecular structure afforded by the spectra of bodies, that concerning the arrangement of the atoms in the molecule on the supposition that the atoms are vortex-rings, and the electrical theory of molecular structure, first brought forward by Helmholtz in his Faraday Lecture, are all clearly discussed; and the author's own researches on the conduction of electricity by gases, which bear out the results of this latter theory, are adverted to. The whole article, which only extends over seven pages, forms an admirable exposition of a most important, if a somewhat difficult, subject, and shows what chemistry gains from the work of mathematical physicists.

Another short but excellent article is that by Mr. Shenstone, on ozone, including, as it does, the most recent work on the subject, as well as a *résumé* of the older and better known results. The question as to the relation existing between the quantity of ozone produced and the potential difference between the discharging surfaces, does not appear to have as yet been settled, though Berthelot finds that an increase of potential produces an increased yield of ozone. Nor has the exact influence of temperature and pressure been properly made out, though it appears that at a pressure of about 50 mm. ozone is alternately produced and destroyed. These facts point to the conclusion that, although much labour has already been spent upon the investigation of ozone, much yet remains to be accomplished before our knowledge of "modified oxygen" is anything like complete.

Of the recent progress made in our general chemical conceptions, none are of greater, if any are of as great, importance as the foundation of the periodic law by Mendeleeff in 1869. A Dictionary which failed to give an account, not only of the nature of this law, but also of its rise and development, would indeed be incomplete. Mr. Douglas Carnegie's article, however, does justice to his subject, and I am glad to see he has not ignored the extensions made by my lamented pupil and friend, Carnelly, which are truly said to be as much in advance of the earlier views of Dumas and Gladstone as the periodic law is in advance of the earlier disconnected schemes of classification. And I agree with the writer in his remarks that if these extensions must be regarded as bold speculations, they indicate the direction in which investigations on the *rationale* of the periodic law, and of the nature of the elements, will probably have to be prosecuted before we can hope to arrive at any explanation of the law, or of the nature of the chemical elements themselves.

The article on "Metals (rare)" is, of course, contributed by Mr. Crookes. It contains an account of the contributor's own researches on the splitting up of the rare earth metals. Many of the metals described in our treatises, and in the Dictionary itself, are probably mixtures. Some years ago I proved that an element termed philippium was in reality a mixture of two others, viz. terbium and yttrium, and Mr. Crookes's researches have since confirmed my results. It is, however, quite true, as Crookes observes, that until we know what terbium and yttrium themselves are, we have not got to the bottom of the question. And from his own work it does not appear very likely that the chemists of this generation will bottom this subject, for the more Mr. Crookes works on the separation of these bodies the more complex does the question of identification appear to become. Those who wish to form an idea of the character of work of this kind will do well to study the article.

A notable characteristic of this Dictionary is the summation of the properties of the different allied groups of chemical elements. Thus in this volume we find an excellent article by one of the editors, Mr. Pattison Muir, on the nitrogen group of elements. The relationships between the corresponding compounds of two different members are clearly set forth in tabular form, and thus the reader is able at a glance to compare the analogies and differences which these compounds exhibit both in composition and properties.

Prof. Armstrong's article on isomerism bears out the author's reputation for clear statement and complete knowledge of his subject. He fully discusses its historical development, strengthening his statements by valuable quotations from the writings of chemists of eminence, and brings the matter up to the latest views of chemists such as Van't Hoff, Victor Meyer, Wislicenus, and others, who have recently contributed to our knowledge of isomeric bodies.

For the rest, which indeed forms the bulk of the volume, I must content myself with saying that the numerous articles descriptive of organic compounds, ranging from indin on p. 1 to phenyl-tetrazole carboxylic acid on p. 858 (not to mention the inorganic compounds) are mainly contributed by Dr. H. Forster Morley, one of the editors. How far these hundreds of compounds are adequately described, or what mistakes of omission or commission the descriptions may contain, or how many printers' errors exist, must be left to be determined, if determined at all, by someone with more leisure, and, may I add, with more taste for that sort of work than I possess. But I may conclude by saying that, knowing the accuracy and care which uniformly characterize Dr. Morley's work, I do not think that any adverse critic, if such there should be, of this great addition to our chemical literature, will find it a very happy hunting-ground, for, as far as I am able to judge, the work has been carefully and accurately done. H. E. Roscoe.

THE ENGLISH SLÖJD.

Manual Instruction; Wood-work; the English Sloyd. By S. Barter. With 302 Illustrations. Preface by George Ricks, B.Sc.Lond. (London: Whittaker and Co., 1892.)

It is to be regretted that the author of this very excellent and practical work should not have stated on the title-page what it really is, *i.e.* a book simply teaching carpentry, including directions for a limited amount of technical or mechanical drawing, and not have termed it "Wood-work," since by this term much is understood which is not given in his pages. Neither is there any occasion for the word which he gives in one place as *Sloyd* and in others as *Slöjd*, it being sufficiently misused already in Swedish by being confined to common incised carving and small carpenter's work, when it is properly applicable to all kinds of technical art. Since Mr. Barter has had the intelligence and boldness to declare that whatever can be done with the barbarous "*Slöjd*" knife can be better done with the chisel, it is to be regretted that, as he is with his English common-sense altogether out of and beyond *Slöjd*, he did not let the Swedish system alone altogether. There was no occasion for him to mention it or its palpable defects, to which he might have added the preposterous arrogance of its claims to be the incarnation of all that is needed to train the hand and eye to industrial art. However, since he who is fitter to be the leader humbly assumes the name, and follows the lead as an English *Slöjder*, we, of course, cannot complain, since it is to his own disadvantage that he assumes a title which detracts seriously from the merits of the treatise. He gives a very good introduction on drawing, which has, however, the serious defect of being beyond the capacity of mere boys, who, while at carpenters' work, certainly cannot be expected to devote hours to learning the meaning and application of "orthographic projection," "the assumption of the existence of parallel horizontal rays of light which project the elevation on a vertical surface," "isometric axes," and "therefore as AC is to CH : : $\sqrt{3}$: $\sqrt{2}$; but CH = A'K, which is," *et cetera*—all of which, with the diagrams, contrasts strangely with the pictures of the ten-year-old chubby youngsters who are represented as merrily sawing and planing in the frontispiece. It is true that there are little boys who can master Euclid, or its equivalents ; but an experience of years in teaching qualifies us to state that a much more simply written chapter than this, or one within the ready comprehension of "boys," would have been better adapted to the book. The forty-two pages devoted to timber are thoroughly scientific, practical, and admirable. Yet as boys seldom have any great choice of wood, and have little to do with teak, ebony, and lignum vitæ, much of the space might have been better devoted to some kind of wood-work not touched on in this book. Materials and tools are well described. We observe that in his illustrations of nails Mr. Barter makes no mention of the very best of all—the triangular, which goes home as straight as a screw, and holds like one.

"Bench-work" is the best portion of the book, being thorough, comprehensive, and manifestly written by a master of the subject. It is not beyond the comprehension of an intelligent boy who will devote to it serious attention ; therefore, for such as are somewhat advanced, it may be warmly commended, for the simple reason that intelligent minds pay most serious attention to, and remember best, what costs them some trouble. The author is evidently a very practical, serious, and earnest mechanic, who, understanding his business perfectly, describes everything as he would teach it to a class of young men who had been a while in workshops. But with his "orthographic projections" as with his whole style, he is—not invariably, nor even generally, but very often—too hard for urchins; and, in fact, the juvenile who is depicted on p. 175 as boring a hole has appropriately the pensive air of one who is very much bored himself—probably by some difficulty in the text. Yet all of this does not detract from the fact that the work is an admirable one, that it is the best of its kind, and perfectly adapted to the use of teachers establishing classes, who are, after all, the only persons who really need or read such works, as pupils seldom look at anything of the kind unless required to. But though it is very seldom done, it would have good results if pupils in technical schools should be made to read more, and secondly, if the teacher should carefully explain to them the text.

An excellent feature in the bench work is that the author, giving the names of a majority of such objects as an amateur may expect to make, describes in detail, with excellent and abundant illustrations, how to make them. He might in some cases have gone a little further in his work. Thus it never appears to have occurred to him that parquetry, or inlaid work, can be made save by sawing out pieces of wood in their natural colours. But a large portion of French and Italian work is made by using wood which is artificially coloured, and we should not have expected this to be passed over by a writer who had the intelligence to remark that "Colour, which plays so prominent a part in design, is entirely overlooked in he Slöjd system," which it certainly is, and with it much